

CLAIMS

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1. A material for a solid polyelectrolyte, comprising a multi-segmented fluoropolymer having at least two types of fluoropolymer chain segments differing in monomer composition, at least one type of the fluoropolymer chain segments containing sulfonic acid functional groups.

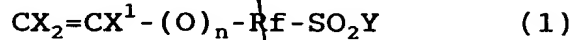
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2. The material according to Claim 1, ^{comprising} ~~which~~ ~~comprises~~ a multi-segmented fluoropolymer having a fluoropolymer chain segment A containing sulfonic acid functional groups and a fluoropolymer chain segment B containing no sulfonic acid functional groups, the fluoropolymer chain segment B having a crystalline melting point of 100°C or higher or a glass transition point of 100°C or higher.

3. The material according to Claim 2, wherein the fluoropolymer chain segment A containing sulfonic acid functional groups is a copolymer comprising:
(a) an ethylenic fluoropolymer unit containing sulfonic acid functional groups; and
(b) at least one type of ethylenic fluoromonomer unit copolymerizable with the unit (a), and containing no sulfonic acid functional groups.

4. The material according to Claim 3, wherein the ethylenic fluoromonomer unit (a) containing sulfonic

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acid functional groups is represented by Formula (1)

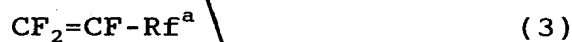


wherein X and X¹ may be the same or different and are each hydrogen or fluorine; Y is F, Cl or OY¹ wherein Y¹ is

5 hydrogen, alkali metal or C₁ to C₅ alkyl; Rf is C₁ to C₄₀ divalent fluoroalkylene or C₁ to C₄₀ divalent fluoroalkylene having ether bond(s); and n is 0 or 1.

13 B2 8. The material according to Claim 3, wherein the at least one type of ethylenic fluoromonomer unit (b) contains no sulfonic acid functional groups ^{comprises} is tetrafluoroethylene.

A 10 6. The material according to Claim 2, wherein the fluoropolymer chain segment B is a polymer chain comprising 85 to 100 mol% of tetrafluoroethylene and 15 to 15 0 mol% of a monomer represented by Formula (3)



wherein Rf^a is CF₃ or ORf^b wherein Rf^b is C₁ to C₅ perfluoroalkyl.

20 7. The material according to Claim 2, wherein the multi-segmented fluoropolymer has an equivalent weight of 400 to 1600.

A A 8. The material according to Claim 1, ^{comprising} ~~which~~ ~~comprises~~ a multi-segmented fluoropolymer having at least two types of fluoropolymer chain segments C and D 25 containing sulfonic acid functional groups, the

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fluoropolymer chain segment C having a smaller equivalent weight than the fluoropolymer chain segment D.

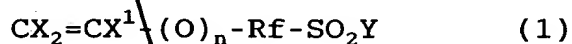
9. The material according to Claim 8, wherein the fluoropolymer chain segment D has a crystalline melting point of 100°C or higher or a glass transition point of 100°C or higher.

10. The material according to Claim 8, wherein the fluoropolymer chain segments C and D containing sulfonic acid functional groups are each a copolymer comprising:

(c) an ethylenic fluoromonomer unit containing sulfonic acid functional groups; and

(d) at least one type of ethylenic fluoromonomer unit copolymerizable with the unit (c) and containing no sulfonic acid functional groups.

11. The material according to Claim 10, wherein the ethylenic fluoromonomer unit (c) containing sulfonic acid functional groups is represented by Formula (1)



wherein X, X¹, Y, n and Rf are as defined above.

12. The material according to Claim 8, ^{comprising} ~~which is~~ the multi-segmented fluoropolymer in which the fluoropolymer chain segment D has an equivalent weight of 1000 or more.

13. A material according to Claim 8, wherein the

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multi-segmented fluoropolymer has an equivalent weight of 400 to 1600.

14. A solid polyelectrolyte membrane comprising the multi-segmented fluoropolymer according to Claim 2 ~~or~~

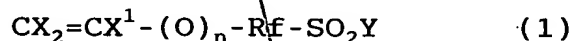
15. The solid polyelectrolyte membrane according to Claim 14, wherein the multi-segmented fluoropolymer contains protonated sulfonic acid (SO_3H) groups as the sulfonic acid functional groups, and has a modulus of elasticity of at least 1×10^8 dyn/cm² at 110°C or higher.

16. The solid polyelectrolyte membrane according to Claim 15, wherein the equivalent weight of the whole multi-segmented fluoropolymer is 1600 or less.

17. A multi-segmented fluoropolymer having a fluoropolymer chain segment A¹ containing sulfonic acid functional groups and a fluoropolymer chain segment B¹ containing no sulfonic acid functional groups, wherein:

the fluoropolymer chain segment A¹ containing sulfonic acid functional groups is a copolymer having a molecular weight of 5000 to 750000 and comprising:

(e) 1 to 50 mole% of at least one type of structural unit represented by Formula (1)



wherein X, X¹, Y, n and Rf are as defined above, and

(f) 99 to 50 mol% of at least one type of ethylenic

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monomer structural unit containing no sulfonic acid functional groups; and

the fluoropolymer chain segment B¹ is a fluoropolymer chain containing at least one type of ethylenic fluoromonomer unit and having a molecular weight of 3000 to 1200000.

18. The multi-segmented fluoropolymer according to Claim 17, wherein the ethylenic fluoromonomer (e) in the fluoropolymer chain segment A¹ is represented by Formula (2)



wherein Y and Rf are as defined for Formula (1).

19. The multi-segmented fluoropolymer according to Claim 17, wherein the ethylenic monomer (f) in the fluoropolymer chain segment A¹ contains at least one ethylenic fluoromonomer.

20. The multi-segmented fluoropolymer according to Claim 19, wherein the ethylenic monomer (f) is tetrafluoroethylene.

21. The multi-segmented fluoropolymer according to Claim 17, wherein the fluoropolymer chain segment B¹ is a polymer chain comprising 85 to 10 mol% of tetrafluoroethylene and 15 to 0 mol% of a monomer represented by Formula (3)

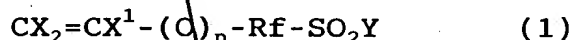


wherein Rf^a is CF_3 or ORf^b wherein Rf^b is C_1 to C_5 perfluoroalkyl.

22. A multi-segmented fluoropolymer having at least two types of fluoropolymer chain segments C^1 and D^1 containing sulfonic acid functional groups, wherein:

the fluoropolymer chain segment C^1 is a copolymer having a molecular weight of 5000 to 750000 and comprising:

(g) 13 to 50 mol% of at least one type of ethylenic fluoromonomer structural unit containing sulfonic acid functional groups and represented by Formula (1)

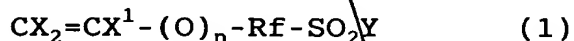


wherein X , X^1 , Y , n and Rf are as defined above, and

(h) 87 to 50 mol% of at least one type of ethylenic monomer structural unit containing no sulfonic acid functional groups; and

the fluoropolymer chain segment D^1 is a fluoropolymer chain having a molecular weight of 3000 to 1200000 and comprising:

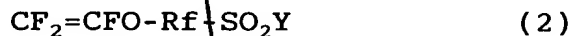
(i) not less than 0.1 mol% but less than 13 mol% of at least one type of ethylenic fluoromonomer unit containing sulfonic acid functional groups and represented by Formula (1)



wherein X , X^1 , Y , n and Rf are as defined above, and

(j) more than 87 mol% but not more than 99.9 mol% of at least one type of ethylenic monomer unit containing no sulfonic acid functional groups.

23. The multi-segmented fluoropolymer according to Claim 22, wherein the ethylenic fluoromonomer (g) in the fluoropolymer chain segment C¹ is represented by Formula (2)

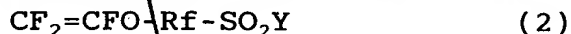


wherein Y and Rf are as defined for Formula (1).

24. The multi-segmented fluoropolymer according to Claim 22, wherein the ethylenic monomer (h) in the fluoropolymer chain segment C¹ contains at least one ethylenic fluoromonomer.

25. The multi-segmented fluoropolymer according to Claim 24, wherein the ethylenic monomer (h) in the fluoropolymer chain segment C¹ is tetrafluoroethylene.

26. The multi-segmented fluoropolymer according to Claim 22, wherein the ethylenic fluoromonomer (i) in the fluoropolymer chain segment D¹ is represented by Formula (2)



wherein Y and Rf are as defined for Formula (1).

27. The multi-segmented fluoropolymer according to Claim 22, wherein the ethylenic monomer (j) in the fluoropolymer chain segment D¹ contains at least one

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ethylenic fluoromonomer.

28. The multi-segmented fluoropolymer according to Claim 27, wherein the ethylenic monomer (j) in the fluoropolymer chain segment D¹ is tetrafluoroethylene.

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